

# Pharmacy Benefits and the Use of Drugs by the Chronically Ill

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**I**N RECENT YEARS, MANY HEALTH plans have implemented policies to contain drug costs, including raising beneficiary co-payments, mandating use of generics, requiring mail-order services, and expanding use of formularies, all of which have large effects on total drug spending. For example, doubling co-payments reduced total drug spending by 19% to 33% in one multiyear study of 25 companies.<sup>1</sup> Such large responses often raise concerns about adverse health consequences, particularly for chronically ill individuals. Indeed, large changes in drug benefits are sometimes associated with substantial morbidity and mortality in certain high-risk populations.<sup>2-4</sup>

In the privately insured nonelderly population, the patterns may differ. Although there is also evidence that this population changes its patterns of drug use when benefits change, there is less evidence of adverse health consequences. One plausible explanation is that the health consequences manifest over many years, and relevant longitudinal databases are scarce. In addition, there may be different responses, depending on the diseases the drugs treat. Several studies suggest that consumer sensitivity to cost sharing de-

**Context** Many health plans have instituted more cost sharing to discourage use of more expensive pharmaceuticals and to reduce drug spending.

**Objective** To determine how changes in cost sharing affect use of the most commonly used drug classes among the privately insured and the chronically ill.

**Design, Setting, and Participants** Retrospective US study conducted from 1997 to 2000, examining linked pharmacy claims data with health plan benefit designs from 30 employers and 52 health plans. Participants were 528 969 privately insured beneficiaries aged 18 to 64 years and enrolled from 1 to 4 years (960 791 person-years).

**Main Outcome Measure** Relative change in drug days supplied (per member, per year) when co-payments doubled in a prototypical drug benefit plan.

**Results** Doubling co-payments was associated with reductions in use of 8 therapeutic classes. The largest decreases occurred for nonsteroidal anti-inflammatory drugs (NSAIDs) (45%) and antihistamines (44%). Reductions in overall days supplied of antihyperlipidemics (34%), antiulcerants (33%), antiasthmatics (32%), antihypertensives (26%), antidepressants (26%), and antidiabetics (25%) were also observed. Among patients diagnosed as having a chronic illness and receiving ongoing care, use was less responsive to co-payment changes. Use of antidepressants by depressed patients declined by 8%; use of antihypertensives by hypertensive patients decreased by 10%. Larger reductions were observed for arthritis patients taking NSAIDs (27%) and allergy patients taking antihistamines (31%). Patients with diabetes reduced their use of antidiabetic drugs by 23%.

**Conclusions** The use of medications such as antihistamines and NSAIDs, which are taken intermittently to treat symptoms, was sensitive to co-payment changes. Other medications—antihypertensive, antiasthmatic, antidepressant, antihyperlipidemic, antiulcerant, and antidiabetic agents—also demonstrated significant price responsiveness. The reduction in use of medications for individuals in ongoing care was more modest. Still, significant increases in co-payments raise concern about adverse health consequences because of the large price effects, especially among diabetic patients.

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pends on a drug's therapeutic class<sup>4-7</sup> and that increased cost sharing may decrease "nonessential" drug use more than "essential" drug use.<sup>8,9</sup> This makes identifying the therapeutic classes most sensitive to benefit changes critically important.

We examined how changes in benefit design among privately insured populations affect use of the most commonly used drug classes. In addition, we identified populations more likely to be at risk for adverse health effects and isolated their responsiveness to cost sharing.

## METHODS

We assembled a data set of pharmacy and medical claims from 1997 to 2000

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for 30 large US employers covering 528 969 beneficiaries continuously enrolled for up to 4 years (n=960 791 person-years). The claims captured all health care claims and encounters, including prescription drugs and inpatient, emergency, and ambulatory services. Most drug claims included information on the type of drug, drug name, national drug code, dosage, days supplied, and place of purchase (retail or mail order). The medical claims included the date of service, diagnosis and procedure codes, type of facility, and clinician.

We merged the claims data with information on the health insurance benefits for each covered individual. Most of the companies offered employees a choice of health insurance plans, yielding data from 52 health plans (n=102 plan-years). These plans varied across companies and by year because some of them changed their benefits structure during the observation period. Although employees typically had a choice of medical plans, only 2 companies had drug benefits that differed across the plan options, thereby reducing potential bias from selection of drug plans according to anticipated use.

For each plan-year, we obtained copies of the summary benefit design. Salient benefit information was then abstracted by 2 members of the research team. The few instances in which there were discrepancies were resolved with a third opinion from one of the principal investigators. Abstracted drug-benefit details included co-payments or coinsurance rates for retail and mail-order pharmacies, generic substitution rules, and a list of drugs or drug classes excluded from coverage. Characteristics of the medical benefit included deductibles and patient cost-sharing arrangements for inpatient and ambulatory settings. The result was a data set linking covered beneficiaries' drug use and insurance benefits for approximately 1 million person-years.

### Classification of Drugs

We used a common classification scheme—the *2000 Red Book*<sup>10</sup>—to as-

**Table 1.** Therapeutic Classes Ranked by Spending, 2000

Therapeutic Class	2000 Spending, \$*	Share of Total Spending, %
Antihyperlipidemics	25 200 949	9.7
Antidepressants	22 631 195	8.7
Antiulcerants	21 399 882	8.2
Nonsteroidal anti-inflammatories	12 531 042	4.8
Antihistamines	11 682 117	4.5
Antidiabetic agents (excluding insulin)	11 633 114	4.5
Calcium channel blockers	9 626 212	3.7
Angiotensin-converting enzyme inhibitors	8 272 057	3.2
$\beta$ -Blockers	4 867 077	1.9
Histamine (H <sub>2</sub> ) antagonist	4 331 444	1.7
Above 10 classes	132 175 088	50.8
All drugs	260 355 707	100.0

\*Spending is for a sample of 322 556 beneficiaries aged 18 to 64 years and with employer-sponsored drug coverage in 2000.

sociate each drug with a therapeutic class. TABLE 1 shows the 10 most common therapeutic classes (in terms of dollars spent) in our sample for 2000. Together, these 10 classes accounted for more than \$132 million in sales across all plans in our sample and 51% of all drug spending. Not surprisingly, the best-selling drugs include treatments for high cholesterol, depression, gastrointestinal disorders, joint pain, allergies, and heart disease.

### Price Index of Plan Generosity

Our key independent variable was an index of plan generosity. In general, it is difficult to translate the stated pharmacy benefit into actual prices that consumers face. Multitier formularies are the standard for most private plans, and they also offer discounts for purchases through mail-order or in-network pharmacies. These added complexities mean that the price a consumer will pay for a given drug depends not only on which tier it is placed in but also on where it is dispensed. To address this issue, we constructed a price index for the pharmacy benefit according to cost sharing for a standardized list of drugs.

The index represents the expected out-of-pocket spending in each plan for a standardized “market basket” of drugs. The market basket was generated by drawing a representative sample of 100 enrollees from each plan who

had at least 1 drug claim, which was done separately for each year. We then compiled a list of all the drugs purchased by these beneficiaries and aggregated this list across plans to yield the market basket. To assign prices, we used the average co-payment for each drug in each plan. In this way, our price for a drug reflected not only the way a drug was tiered but also these other factors, such as the accessibility of network pharmacies. Formally, the index is computed as a weighted sum of average co-payments for each drug in the market basket, where the weights reflect the per-beneficiary number of prescriptions filled for each drug.

### Multivariate Regression

We modeled the likelihood that beneficiaries used any drugs in a therapeutic class, as well as their spending, contingent on having filled at least 1 prescription in that class. We estimated these outcomes by using a 2-part model estimated separately for each therapeutic class. We used probit regression to estimate the probability that a member had at least 1 pharmacy claim in the class. The second part of the model used a generalized linear model to estimate drug spending among members who were users. We chose a generalized linear model with a logarithmic link function because it predicted days supplied better than a 2-part model with log-linear regression in the sec-

**Table 2.** Selected Plan and Patient Characteristics\*

	Type of Plan			
	1-Tier	2-Tier	3-Tier	Coinsurance
Person-years, No.	329 827	343 117	145 630	142 217
<b>Plan Characteristics</b>				
Average co-payment, \$ Retail				
Generics	6.05	6.31	5.70	24%
Preferred brands	6.05	12.85	11.11	24%
Nonpreferred brands	6.05	12.85	20.81	24%
Mail order				
Generics	9.60	11.56	8.91	24%
Preferred brands	9.60	19.71	17.59	24%
Nonpreferred brands	9.60	19.71	33.02	24%
Average price index (SD), \$	124 (24)	168 (42)	179 (36)	181 (36)
<b>Patient Characteristics</b>				
Age, mean (SD), y	45.4 (10.3)	47.2 (10.4)	42.0 (12.1)	49.1 (10.0)
Male sex, %	53	71	44	77
Married, %	62	70	49	71
Urban residence, %	79	80	91	88
Median income in ZIP code, \$	30 555	34 060	36 496	38 294
<b>Conditions, %</b>				
Diabetes	5.4	4.8	4.7	4.1
Arthritis	1.9	1.9	1.8	1.8
Asthma	1.4	1.2	2.0	1.3
Gastric acid disorder	1.8	2.0	2.1	1.6
Hypertension	8.6	11.0	8.6	9.6
Depression	2.5	1.9	2.8	1.7
Dyslipidemia	8.8	10.3	8.3	9.3
Allergic rhinitis	2.0	2.8	3.0	2.7

\*The 24% coinsurance rates on mail order exclude 4 plans that had a flat \$12 co-payment for all mail-order prescriptions. Mail-order co-payments are higher than retail because they generally cover up to a 90-day supply, whereas retail covers only up to 34 days. The average price index reflects the co-payments a beneficiary would make on a standardized list of drugs annually.

ond stage, but our conclusions were insensitive to this choice.

Our therapeutic classes included most of the top-selling drugs, as shown in Table 1. We combined several classes used to treat the same chronic disease. For antihypertensives, we included angiotensin-converting enzyme inhibitors, calcium channel blockers, diuretics,  $\beta$ -blockers, and angiotensin II receptor blockers. Antidiabetes drugs included sulfonylureas and other oral agents such as metformin and glitazones. Insulin was not included because injectable drugs often have different benefits. Antiulcerants included H<sub>2</sub> receptor antagonists and proton pump inhibitors, as well as other gastrointestinal drugs not elsewhere classified. Antidepressants included selective serotonin reuptake inhibitor and tricyclic

drugs. Nonsteroidal anti-inflammatories included the cyclooxygenase 2 inhibitors. Antiasthmatics included anticholinergics, anti-inflammatory asthma agents, leukotriene modulators, oral steroids, steroid inhalers, sympathomimetics, and xanthines.

In addition to our index of plan generosity, we included binary indicators identifying plans with coinsurance rates and policies requiring mandatory generic substitution. The latter have been shown to have a large independent effect on spending.<sup>1</sup> Other independent variables in our model included a set of variables to describe the medical benefits: deductibles, co-payments, or coinsurance rates for physician office visits and a binary indicator to identify plans with coinsurance rates for physician office visits. The other co-

variates were binary indicators for age categories, a binary indicator for male sex, median household income in the ZIP code of residence, a binary indicator for active or retired status, a categorical variable for urban residence, and binary indicators for years to control for time trends. We also controlled for comorbid conditions by using a set of disease indicators identified in the medical claims according to *International Classification of Diseases, Ninth Revision (ICD-9)* diagnoses.<sup>1</sup> (Full model results are available from the corresponding authors.)

For each therapeutic class, we used the results from the 2-part model to simulate total days supplied. Specifically, we used estimates from the first part of the model to predict the probability of nonzero days supplied for each person under different values of the co-payment index. We used the second part of the model to predict days supplied contingent on having at least 1 claim. Total days supplied were predicted by using the product of the 2. The predictions were then averaged over all individuals in the sample for each value of the co-payment index. We predicted use for index values of 168 and 336. These values correspond to moving from a 2-tier plan with co-payments of \$6.31 for generics and \$12.85 for brand drugs to one with co-payments of \$12.62 and \$25.70, respectively. Although the index value of 336 was not observed in our sample, this level corresponds to co-payments observed recently in the marketplace. Simulations of a 50% increase (using values within sample) yielded proportionately similar results. All costs are in US dollars.

**Chronic Condition Analysis**

Patients were identified as having a chronic condition if their medical claims included 2 or more office visits with the corresponding ICD-9 code (available on request) and they filled at least 1 prescription for the listed therapeutic class. The chronic population varied by therapeutic class: depression (for antidepressants), hyperten-

sion (antihypertensives), hypercholesterolemia (antihyperlipidemics), gastric acid disorder (antiulcerants), asthma (antiasthmatics), diabetes (antidiabetics), arthritis (nonsteroidal anti-inflammatory drugs [NSAIDs]), and allergic rhinitis (antihistamines). Patients with multiple conditions were included in each relevant subgroup (eg, patients with diabetes and hypertension were included in the diabetes and hypertension analyses). For each subgroup, we estimated 2 models: 1 for disease-specific drug use and 1 for use of all other drugs. As an example, for individuals who had hypertension and met the criteria above, we estimated their use of antihypertensives and all other nonhypertensive medications. We then predicted use for each group and each measure by following the methods outlined above.

The RAND Human Subjects Protection Committee ruled that this research was exempt from institutional review board approval.

## RESULTS

TABLE 2 shows the characteristics of the plans in our study sample. We broadly classified our plans into 1-tier, 2-tier, 3-tier, or coinsurance plans, with between 142 217 and 343 117 person-years for each type. The 1-tier plans are the most generous; these plans require on average a \$6.05 payment per retail prescription for a 30-day supply. Co-payments are higher on mail-order prescriptions (averaging \$9.60 per prescription), but they allow up to a 90-day supply. Average retail co-payments in a 2-tier plan are \$6.31 for generic drugs and \$12.85 for brand drugs. Average co-payments in a 3-tier plan range from \$5.70 to \$20.81. Mail-order co-payments for 2-tier and 3-tier plans range from \$8.91 for generics in a 3-tier plan to \$33.02 for nonpreferred brands.

The relative generosity of the plan is conveyed by the average price index, which reflects average patient out-of-pocket spending for our market basket of drugs. Our generosity index had an overall mean of \$150, a median of

**Table 3.** Unadjusted Per-Member Annual Days Supplied for Various Drug Classes\*

Therapeutic Class	Patients With $\geq 1$ Filled Prescription, %	Days Supplied for Patients With $\geq 1$ Prescription	Days Supplied for All Patients
Antihypertensives	22	386	85
ACE inhibitors	9	276	23
$\beta$ -Blockers	8	261	21
Calcium channel blockers	7	269	19
Diuretics	7	220	16
Angiotensin II receptor blockers	3	248	6
Nonsteroidal anti-inflammatories	19	74	14
Antihistamines	17	90	15
Antidepressants	12	216	25
Antihyperlipidemics	11	269	29
Antiulcerants	11	181	20
Other (includes PPI)	7	180	13
Antiasthmatics	9	117	10
Antidiabetics	4	390	17
Sulfonylureas	3	274	8
Other (includes metformin)	3	291	8

Abbreviations: ACE, angiotensin-converting enzyme; PPI, proton pump inhibitor.

\*Antihypertensive agents include the 5 subclasses listed here, as well as cardiac drugs not elsewhere classified. Antidiabetic agents include the 2 subclasses listed. Antiulcerants include  $H_2$  receptor antagonists and PPI drugs, as well as other gastrointestinal drugs not elsewhere classified. Antidepressants include selective serotonin reuptake inhibitor and tricyclic drugs. Nonsteroidal anti-inflammatories include cyclooxygenase 2 inhibitors. Antiasthmatics include anticholinergics, anti-inflammatory asthma agents, leukotriene modulators, oral steroids, steroid inhalers, sympathomimetics, and xanthines.

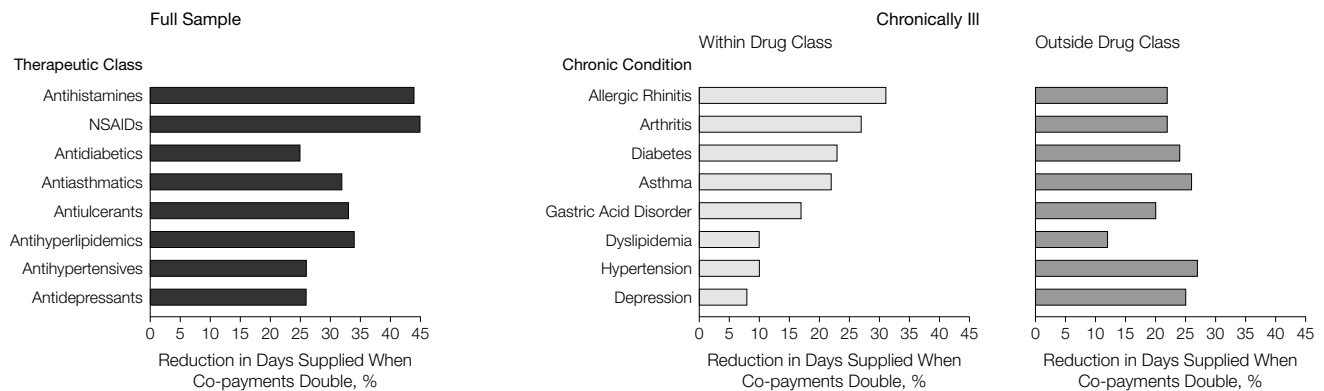
\$136, and an interquartile range of \$120 to \$184 at the plan level ( $n = 102$ ). Within plan type, 1-tier plans were the most generous (index value of \$124), followed by 2-tier plans (\$168), 3-tier plans (\$179), and then coinsurance (\$181). The demographic characteristics of patients enrolled in each plan type differed; for example, men made up 61% of the sample—not surprising, given that this was a sample of primary beneficiaries—but the proportion varied considerably by plan type. These differences underscore the importance of our multivariate approach. On the other hand, the prevalence of chronic disease was fairly similar across plan types, which suggests that unobserved health differences were probably minimal.

TABLE 3 shows annual drug use in each therapeutic class. On the whole, antihypertensives were used most frequently (22% of the population). NSAIDs (19%), antihistamines (17%), antidepressants (12%), and antihyperlipidemics (11%) were also used frequently. Antidiabetes drugs (390 days) and antihypertensives (386 days) were

used most heavily, reflecting the chronic nature of these conditions and their treatment. In contrast, NSAIDs (74 days), antihistamines (90 days), and antiasthmatics (117 days) were not used continuously throughout the year by most patients. These findings suggest a classification of medications into 3 broad groups: drugs that forestall disease progression and avoid long-term complications (antidiabetics, antihypertensives, and antihyperlipidemics), medications that largely treat symptoms or intermittent conditions (NSAIDs and antihistamines), and drugs with characteristics of both (antidepressants, antiulcerants, and antiasthmatics).

The FIGURE shows the predicted effects of doubling co-payments in each therapeutic class for the entire sample and a subset of patients receiving ongoing treatment for a chronic illness. We predicted the percentage change in annual days supplied in response to a doubling of co-payments after adjusting for demographic and health characteristics. The change was computed by predicting use for a drug plan with an index value of 336, with predicted

**Figure.** Predicted Change in Annual Days Supplied When Co-payments Double by Drug Class and Population



The percentage change in per-member annual days supplied when co-payments increase by 100% in the average 2-tier plan is shown. This plan has retail co-payments of \$6.31 for generics and \$12.85 for brand-name drugs and has an index value of 168. For each chronically ill subpopulation, we estimated the change in drug use within class (eg, use of antidepressants by depressed patients) and outside of class (eg, use of all other medications by depressed patients) when co-payments increase by 100%. NSAIDs indicates nonsteroidal anti-inflammatory drugs.

**Table 4.** Predicted Change in Medication Use When Co-payments Are Doubled for Chronically Ill Patients\*

Chronic Medication	Change in Days Supplied, %
OTC substitutes	
Close substitutes	-32
No close substitutes	-15
Type	
Brand	-21
Generic	-16

Abbreviation: OTC, over-the-counter.

\*Predicted change in annual days supplied when co-payments are doubled. Chronic medications with close OTC substitutes consist of antiulcerants (H<sub>2</sub> receptor antagonists and proton pump inhibitors), NSAIDs, and antihistamines. Chronic medications without close OTC substitutes include antidiabetics, antiasthmatics, antihyperlipidemics, antihypertensives, and antidepressants.

use for a plan with an index value of 168, which corresponds to the effect of co-payments in a 2-tier plan increasing from \$6.31 for generics and \$12.85 for brand drugs to \$12.62 and \$25.70, respectively. For the entire study sample, we observed substantial reductions in spending for all classes of drugs. The largest decreases occurred for NSAIDs (45%) and antihistamines (44%). But the most striking feature is the much lower responsiveness among chronically ill patients. For example, use of antidepressants by depressed patients declined by only 8% when co-payments doubled compared with 26% overall. Use of antihypertensives was reduced by 26% for the entire population compared with only 10% among

individuals with diagnosed hypertension. The lone exception was patients with diabetes: their response to a doubling of co-payments (23%) was virtually identical to that of the overall population (25%).

The Figure also compares use within class and outside class for chronically ill patients only. Use of antidepressants by depressed patients declined by 8% when co-payments doubled; however, their use of all other drugs declined by 25%. Use of antihypertensives by patients with high blood pressure declined by 10%, whereas their use of all other drugs decreased by 27%. Similar but less dramatic differences emerged for antihyperlipidemics, antiulcerants, and antiasthmatics. For antihistamines and NSAIDs, the pattern reversed. Patients with arthritis and allergic rhinitis reduced their disease-specific use by 27% and 31%, respectively, whereas their use of other drugs actually declined by only 22%.

One might expect to see more price responsiveness for drugs with close over-the-counter (OTC) substitutes or for higher-priced medications. TABLE 4 presents the predicted change in annual days supplied when co-payments are doubled for people with 1 of 8 chronic conditions. Medications with OTC substitutes included NSAIDs, antihistamines, and antiulcerants (H<sub>2</sub> re-

ceptor antagonists and proton pump inhibitors). We found that a doubling of co-payments led to a 32% reduction in their use. Use of medications without close OTC substitutes—defined as antidiabetics, antiasthmatics, antihyperlipidemics, antihypertensives, and antidepressants—decreased by only 15%. In contrast, we saw only modest differences by drug type (21% for brand name vs 16% for generic). Taken together, the results suggest that patients are more likely to forgo higher-priced medications and substitute less-expensive OTC medications when possible as their out-of-pocket burden increases.

**COMMENT**

In previous work, we found considerable price sensitivity in the demand for prescription drugs among a working-age population with employer-provided insurance.<sup>1</sup> In that study, doubling co-payments in a 2-tiered plan reduced overall drug spending by one third, but it is unclear which therapeutic classes were most affected. The results presented here demonstrate that doubling co-payments in a typical 2-tier plan is associated with significant reductions in use across 8 of the most widely prescribed therapeutic classes. The largest reductions were for drugs with close OTC substitutes that pri-

marily treat symptoms rather than the underlying disease. Doubling co-payments was associated with reduced annual days' supply of antihistamines and NSAIDs of about 45%; by comparison, use of antihypertensives and antidepressants decreased by 26%.

Patients do not respond indiscriminately to co-payment increases. Individuals receiving treatment for a specific condition are less likely to reduce their use of disease-specific medications. For example, patients with diagnosed high blood pressure reduced use of other drugs by 27% when co-payments doubled but only by 10% for their antihypertensive medication (Figure). Because the average patient with high blood pressure uses 386 days of antihypertensive medications annually (Table 3), these estimates imply that a doubling of co-payments would reduce days supplied by more than 1 month (38.6 days).

This pattern—less responsiveness to price changes for disease-specific medications relative to all other medications—was found in 5 of the 8 therapeutic classes we studied (antidepressants, antihypertensives, antihyperlipidemics, antiulcerants, and antiasthmatics). Use of antihistamines and NSAIDs by people with allergic rhinitis and arthritis, respectively, operated in the opposite direction, meaning that these patients were price sensitive when taking their disease-specific medications. Patients diagnosed with diabetes were a notable exception; use of antidiabetes medications and nondiabetes medications decreased by about one quarter in response to a 100% increase in co-payments. According to Table 3, annual days supplied decreased by more than 3 months when co-payments doubled (from 390 to 293 days). In supplemental analyses, we found that use of insulin, which we purposely excluded from the antidiabetes class because it is often covered differently by plans, was less responsive to benefit changes, with use decreasing by only 8% when co-payments doubled.

The populations most sensitive to price changes were the patients taking

long-term medications but who were not receiving ongoing care for the condition (at least 2 medical visits per year for that condition). More research is needed to determine whether this price-sensitive population consists of people at risk for a disease or for whom the disease is well controlled and who do not seek regular care or people with advanced disease who are not being treated appropriately. Some of this price sensitivity may be beneficial for society in the sense that it reduces excess consumption of drugs whose costs are greater than the (monetized) health benefit. On the other hand, recent evidence suggests that there may be substantial therapeutic benefits of lowering blood pressure and serum cholesterol level for all individuals at risk, not simply those with elevated rates.<sup>11</sup> A recent clinical trial also demonstrated that metformin can prevent or delay the onset of type 2 diabetes in patients at risk (although not as well as diet and exercise).<sup>12</sup>

When we examined the chronically ill population receiving routine care, a group of patients who are most likely to benefit from drug treatment, we still found that doubling co-payments is associated with reductions in drug use of 8% to 23%. Although lower use of antihistamines or anti-inflammatories is unlikely to affect patients' underlying health conditions, significant reductions in the use of antidiabetic agents or medications to treat dyslipidemia may have short- and long-term clinical consequences.

Our findings raise concern that co-payment increases could lead to adverse health consequences, at least for individuals with some conditions. In our sample, we found evidence that co-payment increases led to increased use of emergency department visits and hospital days for the sentinel conditions of diabetes, asthma, and gastric acid disorder: predicted annual emergency department visits increased by 17% and hospital days by 10% when co-payments doubled (data not shown). However, because of limited information about the full extent of medical

benefit coverage and the choice of medical plans (which are self-selected in a way that the drug benefits are not), these results are not definitive. Other studies have found mixed evidence on this issue.<sup>3,13-15</sup>

There are several other limitations. First, our sample was drawn from an insured working-age population, and thus our results are not necessarily generalizable to other populations such as the poor or the elderly. Second, we identified chronically ill patients from claims data. The main concern with this approach is false positives if rule-out diagnoses are recorded on the claims. We tried to minimize this error by restricting our analysis to users of disease-specific drugs, requiring multiple physician visits or hospitalizations for the condition and excluding laboratory claims from our diagnosis counts. Finally, in all but 2 of our companies, beneficiaries did not have a choice of drug benefits; most companies offered the same drug package to all employees even as medical benefits varied. Excluding these companies from our analyses did not appreciably affect the results.

## CONCLUSION

Rapid changes in drug benefits have shifted a larger burden of pharmacy costs onto beneficiaries. Beneficiaries have responded by reducing their use of drugs, but their responsiveness varies substantially among the top-selling therapeutic classes. The use of medications such as antihistamines and NSAIDs that are taken intermittently to treat symptoms is sensitive to co-payment changes. Other medications—antihypertensive, antiasthmatic, antidepressant, antihyperlipidemic, antiulcerant, and antidiabetic agents—also demonstrate significant price responsiveness. However, when one restricts attention to subgroups with identifiable chronic illness, the reduction in use of medications for those conditions is more modest. Still, significant increases in co-payments do raise concern about adverse health consequences because of the large price effects, especially among diabetic patients.

**Author Contributions:** Dr Goldman had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

**Study concept and design:** Goldman, Joyce, Escarce, Solomon, Laouri, Landsman, Teutsch.

**Acquisition of data:** Goldman, Joyce, Solomon, Laouri.  
**Analysis and interpretation of data:** Goldman, Joyce, Escarce, Pace, Solomon, Landsman, Teutsch.

**Drafting of the manuscript:** Goldman, Joyce, Landsman, Teutsch.

**Critical revision of the manuscript for important in-**

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The most exciting phrase to hear in science, the one that heralds new discoveries, is not "Eureka!" (I found it!) but "That's funny . . ."  
—Isaac Asimov (1920-1992)